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ELECTROLYTIC CONDENSER AND METHOD
OF PREPARING ETCHED ELECTRODES
THEREFOR

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7 Claims. (Cl. 175—315)

This invention relates to the method of preparing etched surfaces and particularly etched electrodes for electrolytic devices.

The present application is a continuation-in-part of my co-pending application, Serial Number 734,134, filed July 7, 1934 now Patent No. 2,066,912.

An object of the invention is to improve the methods of preparing etched metal surfaces.

Another object is to provide an etched electrode for electrolytic devices, such as electrolytic condensers.

Other objects of the invention will be apparent from the following description taken in connection with the appended claims.

The present invention comprises the combination of elements, methods of manufacture, and the product thereof brought out and exemplified in the disclosure hereinafter set forth, the scope of the invention being indicated in the appended claims. While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure and the combination of elements without departing from the spirit of the invention.

Dry electrolytic condensers have heretofore utilized sheet foil electrodes usually of aluminum ranging in thickness from .002" to .004" and in width from one inch to three or four inches. These foils have been spaced by a reticular cloth spacer such as disclosed in my United States Letters Patent 1,710,073 and 1,714,191, or by paper spacer as shown in my United States Letters Patent 1,891,206, or by a regenerated sheet cellulose spacer, for instance, "Cellophane" as illustrated in my United States Letters Patent 1,918,716. In the construction of these condensers a spacer of approximately the same dimensions as the foils, is placed on each side of one of the electrodes and the two foils and spacers are then rolled, usually in cylindrical form. Prior to rolling the spacer is impregnated or permeated with a viscous electrolyte so as to afford a conductive path between the electrode foils, although in some cases the condenser roll is assembled and the electrolyte thereafter introduced by impregnation.

It has been long known in the art that if the aluminum plates are etched or otherwise roughened, an increased capacitance is obtained due to increased surface and lower average oxide film thickness formed on such etched plate.

However, the employment of an etching process is limited, due to the fact that the etching solu-

tion tends to dissolve the foil and if the maximum benefit arising from the increased area obtained by a deep etching is desired, it is necessary to use a much thicker foil than would otherwise be required. Furthermore, care must be exercised to prevent the etching from being too deeply applied. These limitations are avoided by the method of etching and the type of electrodes used.

My invention comprises, in its preferred form a novel method of preparing etched electrodes for electrolytic condensers, said electrodes being formed of a metal such as aluminum or tantalum upon which it is possible electrolytically to form a current-blocking film after etching. These metals may be in any suitable form for use, for example, as foil or wire. By the use of wire instead of foil electrodes, the limitation on deep etching is removed and an exceptionally large effective current blocking area is made available without substantially weakening the electrode structure. It will be seen that by using an aluminum wire having a diameter in the order of .040" or a narrow aluminum tape of the same thickness and preferably not more than .15" wide, that it is possible to obtain a very deep etching with consequent increased film blocking area.

The impurities in commercial aluminum are chiefly iron and silicon, although minor amounts of copper are sometimes found. In the A grade, the aluminum content will normally average about 99.2 per cent, with silicon varying from 0.15 to 0.40 per cent and iron varying from 0.25 to 0.70 per cent. The iron content is usually greater than the silicon content. Copper will vary from a trace only to over 0.05 per cent. Sodium is in recent years found only in traces if present at all. Within grade A the present metal is generally reserved for manufacture of electrical conductors on account of its lower electrical resistivity. Electrolytic condenser foil is of very high purity, such as 99.8 to 99.9% pure aluminum.

According to one feature of my invention the etching is controlled so as to avoid too great a reduction in mass of the electrode metal during etching by providing, instead of substantially pure metals, an alloy of such composition as to obtain a selective etching action. For example, I propose to substitute for the pure aluminum foil electrodes of the prior art, an aluminum alloy having a content of a material readily soluble in an etching agent which does not substantially dissolve aluminum, such as nitric acid. For example, adding 10% magnesium to the pure aluminum and etching the electrode in nitric acid, the magne-

5 sium is rapidly etched out and the aluminum, other than becoming slightly oxidized on its surface, is unaffected. For the use with a nitric acid etching agent, an alloy of aluminum with one or
10 more of the metals, calcium, lithium or beryllium may be substituted for the aluminum-magnesium alloy electrode. Neither magnesium, calcium, lithium nor beryllium is present as impurities in electrolytic condenser foil or other grades
15 of commercially pure aluminum.

Generally, it may be stated, with the film forming metal used, whether aluminum or tantalum, that the material alloyed therewith, should be one which is readily capable of being etched out
15 or dissolved by the etching compound and that the etching compound itself should be such as not to adversely attack or affect the film forming metal base. For instance, in place of the nitric acid I may use sulphuric acid, chromic acid or
20 an acid salt such as aluminum ammonium sulphate.

The foil or wire may be prepared as follows for use as electrodes for electrolytic condensers: The foil or wire of aluminum-magnesium alloy
25 is passed through hot nitric acid and the etching accomplished by the dissolving of the magnesium. The etched foil or wire is then film-formed by the customary continuous formation process in an aqueous borax-boric acid solution.
30 After being formed it is dried. The etched and formed material may then be assembled with suitable spacers and electrolyte into electrolytic condensers.

By the use of this process electrodes of high
35 capacity per unit area may be provided, the dissolution of the magnesium (or other alloying metal) leaving a porous etched aluminum surface.

The present invention is applicable to the
40 preparation of electrodes for various electrolytic devices and particularly to the preparation of etched electrodes of film-forming metals for "dry" and "wet" electrolytic condensers.

While the present invention, as to its objects
45 and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

40 What is claimed is:

1. An electrode for electrolytic condensers and the like composed of aluminum of a purity of at least 99.2% having magnesium intentionally al-

loyed therewith, said magnesium being present in a relatively small but appreciable amount, said electrode having an etched roughened surface resulting from the removal of the magnesium
5 from said surface whereby the effective film forming surface of said electrode is greatly increased.

2. An electrode for electrolytic condensers and the like comprising pure aluminum having intentionally alloyed therewith a relatively smaller
10 but appreciable amount of magnesium, said electrode having an etched roughened surface resulting from the removal of the magnesium from said surface.

3. In the process of providing film forming
15 electrodes for electrolytic condensers and the like, the steps of combining with a pure film forming metal such as aluminum, a relatively smaller but appreciable quantity of magnesium, thereafter exposing said metal composition to
20 the action of an etching solution to remove said magnesium from the surface thereof.

4. In the process of providing film forming electrodes for electrolytic condensers and the like, the steps of combining with pure alumi-
25 num, a relatively smaller but appreciable quantity of magnesium, thereafter exposing said metal composition to the action of nitric acid to remove the magnesium from the surface thereof.

5. In the process of providing film forming
30 electrodes for electrolytic condensers and the like, the steps of combining with pure aluminum, a relatively smaller but appreciable quantity of magnesium, thereafter exposing said metal composition to the action of sulfuric acid
35 to remove the magnesium from the surface thereof.

6. An electrode for electrolytic condensers comprising aluminum and a relatively much smaller amount of magnesium, said electrode
40 having an etched surface of high effective electrical capacity resulting from the removal of the magnesium therefrom, and a dielectric oxide film on said surface.

7. An electrolytic condenser comprising two
45 electrodes and an electrolyte, one of said electrodes comprising aluminum, and a relatively much smaller amount of magnesium, said electrode having an etched surface of high effective electrical capacity resulting from the removal of
50 the magnesium therefrom, and a dielectric oxide film on said surface.

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